CALIFORNIA HYDRO SNAPSHOT

Electricity Analysis Office, California Energy Commission

January 29, 2003

Summary

Despite a generally warm and dry January, snowpacks in California are retaining about 8% more water than average for this date. The best reserves are in the Northern Sierra (Figure 1), where snow water content was 133% of average for January 29. Central and Southern Sierra snowpacks are at 99% and 91% of the 50-year mean figures for snow-water content. The January 1 forecast for Sacramento River runoff was pegged at 111% of average, but has since been in gradual decline. This is "normal" weather in the broadest sense, as California's climate and weather patterns oscillate between extremes.

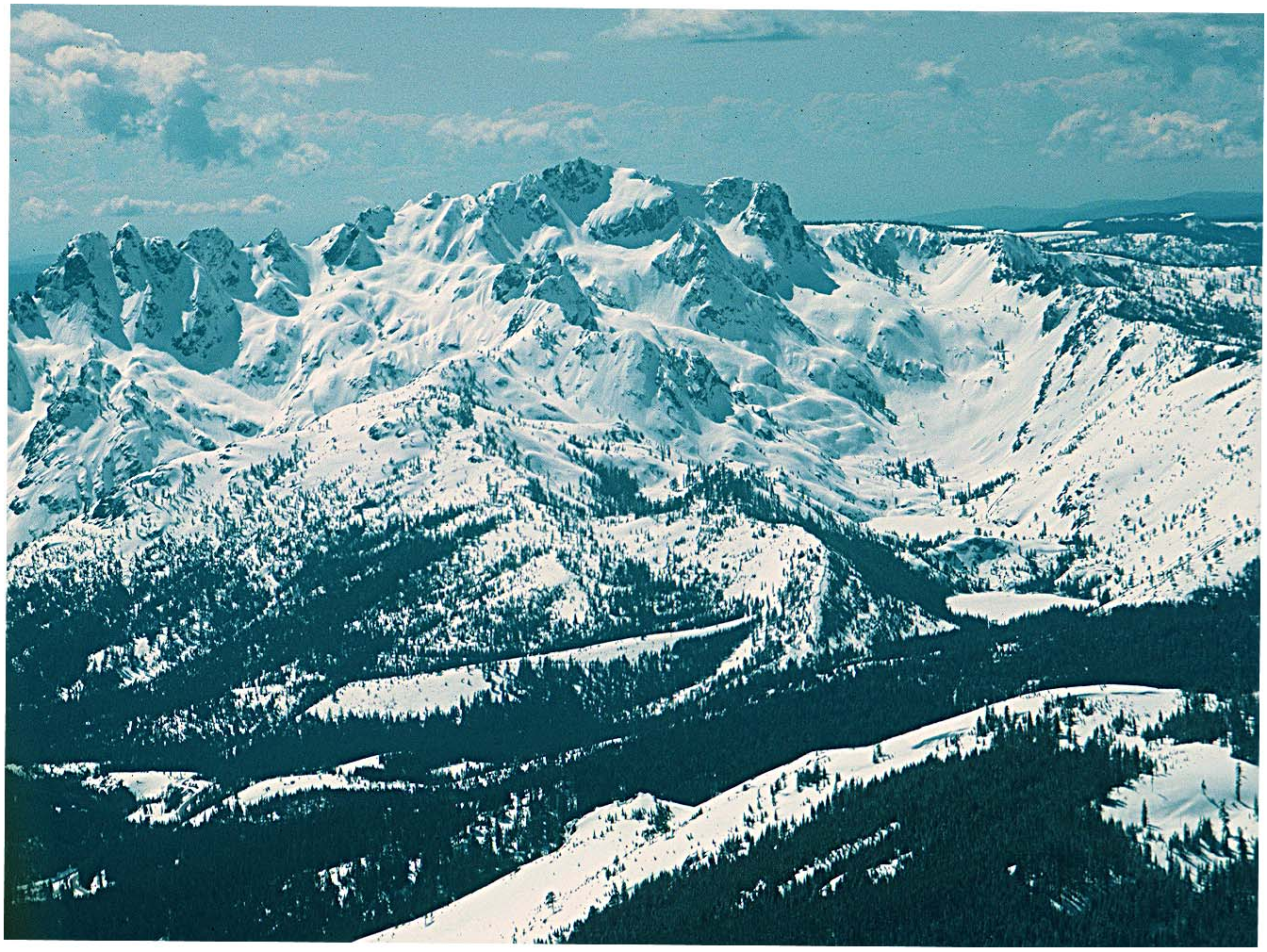
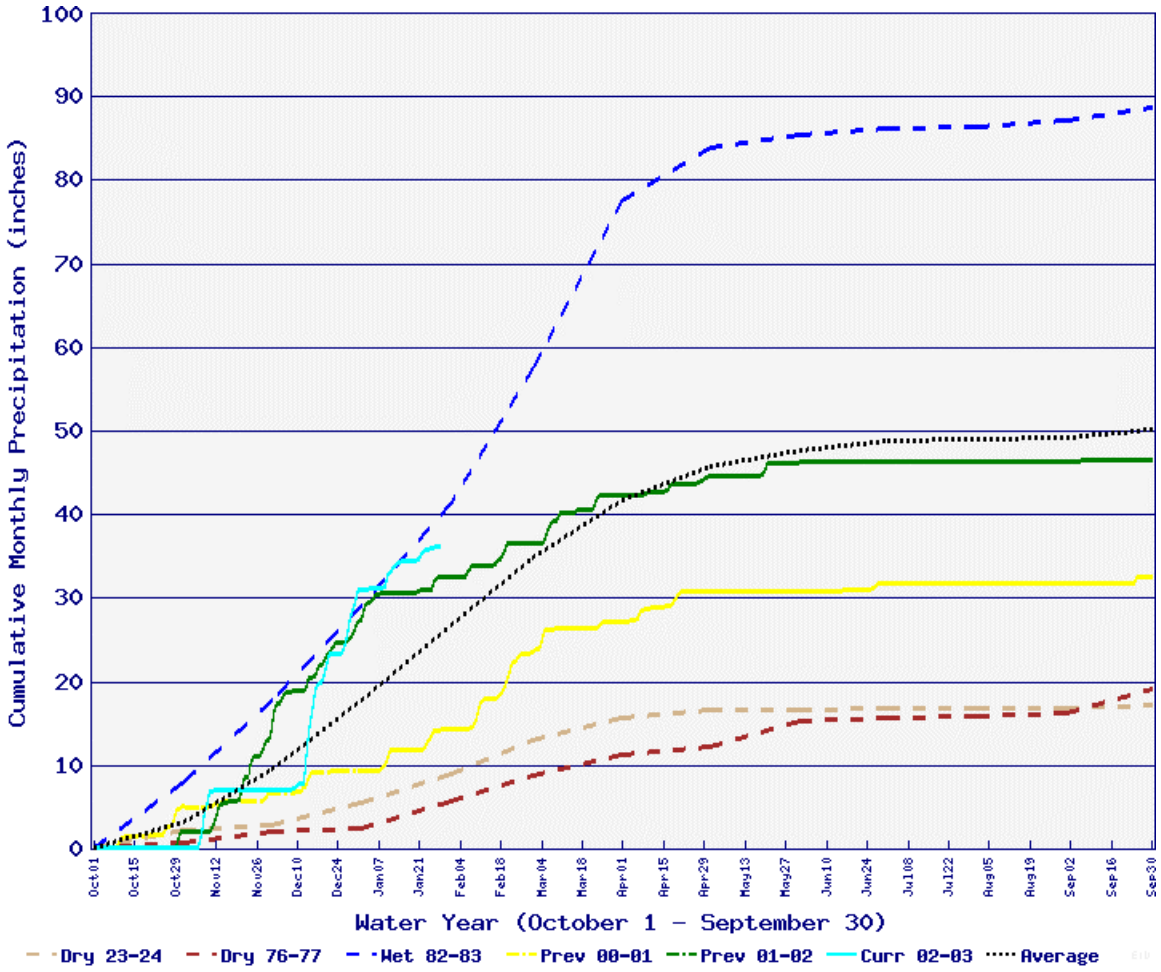


Figure 1. Snowpack around the Sierra Buttes, elevation 8857', aerial view NE in April 1993 (a wet year) by the author.

Our early estimates are that **for 2003, hydroelectric energy** from California's fleet of public, private, and investor-owned plants **will be 110% of average**. This figure will be revised substantially several times over the next three months. It is based on current conditions, confidential utility forecasts, and long-term weather outlooks.

Figure 2 shows that despite the January lull in winter weather, cumulative precipitation in Sacramento Valley (at eight key monitoring sites in the northern Sierra) is still well above average. Water year 2003 it is also ahead of last year, which also began wet and tapered off dry. Note the big stair-step pattern in the light aqua-blue line. This highlights the results of the biggest storms so far this year: before November 12, and after December 10. This index dates back to 1921.

Figure 2. Cumulative precipitation in the Sacramento River hydrologic region since October 1, 2002.



As most water watchers know, the Sacramento River basin, including the Pit, Feather, Yuba, and American rivers, is the most important basin in California for water reception, runoff, storage, interbasin transfers, and hydroelectric energy.

Seasonal Context

The end of January marks the statistical "halfway" point for amounts of precipitation that blow onshore during the water year that begins October 1st. The scientific snow surveys conducted on or about February 1st will provide raw data for the first hydrologic runoff forecasts that have a reasonably broad but statistically based measure of confidence.

One of this winter's January trends all along the Pacific Coast has been relatively high snow levels in the mountains. Consequently, more of the precipitation has fallen as rain. Once soils were saturated by early December storms, more precipitation than usual has quickly runoff to streams and rivers. Not all this runoff can be stored in reservoirs, once they refill to prescribed limits. Releases have kept river levels, such as the Sacramento and the Columbia, at generally high but safe levels, including normal or above-average generation of power.

***El Nino* Effects**

In late December, sea surface temperatures in the Eastern Pacific showed a strong warm-up. As the NE trade winds slowed or stopped in the tropics, a relatively warm and massive body of water moved east towards the South American coast. This is the oscillation called *El Nino*, thought to be the principle driver causing changes in the jet stream. This, in turn, changes the direction of storm tracks. From a land-based perspective, it changes the frequency, intensity, duration, and source latitudes of arriving storms. During *El Nino* years, fewer winter cylones and fronts arrive from the central northern Pacific (centered on the Aleutians). Instead, more weather systems push due east into California from mid-latitudes of the Pacific, or from even farther south in the subtropics with a warm, moist northeast track. Time-lapse maps of sea surface temperatures are accessible on the web at: http:www.cpc.noaa.gov/products/analysis_monitoring/enso_update/index.html

Though the end of *El Nino* is more difficult to predict than the onset, the Climate Prediction Center of the National Weather Service says warm episode conditions are likely to continue. Along the southern tier of the U.S., including southern California, a "wetter-than-average" winter and spring is expected. In the northern tier, including western Canada and southeast Alaska, it will be "warmer-than-average".

For water supplies along the Pacific Coast, there are long-term concerns about potential *El Nino* effects combined with global warming effects, for which 2003 might by a harbinger. For California, the concern is about managing a warmer and smaller snowpack. Statistically, the snowpack reaches its maximum snow-water content between March 27 and April 1. This is also the date when much of the snowpack becomes "ripe", meaning it has warmed up to 32 degrees F. During a typically cold January and February, the snowpack becomes super-chilled, perhaps down to 20 degrees. As the season progresses, the snowpack increases in density, as snow crystals are compacted and air is squeezed out. If a warm storm arrives in March, rain will be absorbed *and cooled to freezing* within the snowpack. This limits the amounts of runoff, and reduces the immediate risk of flooding. As rainfall is frozen into the snowpack, the change in physical state gives off latent heat, slightly warming the snowpack. Fortunately, just as the snowpack warms to 32 degrees about April 1, winter rains taper off sharply, greatly reducing the danger of flooding in the Central Valley. Our state's reservoirs were not designed to manage runoff that would only come from a series of warm-moist mid-winter storms.

Pacific Northwest

In the Pacific Northwest (PNW), 2003 is shaping up as unusually warm and dry. On January 20, the Northwest River Forecast Center predicted that flows on the Columbia River at The Dalles would be just 72% of average for January-July. This was down from December's forecast of 77%. In Washington State, the snowpack is just 59% of average. In Oregon's Willamette basin, snowpack amounted to just 48% of the average for January 22. The precip season runs longer in the PNW than in California, but the chances of having median runoff for 2003 are already considered very low. Climate forecasters believe drier than average conditions will continue through April, especially west of the Cascades (Figures 3 and 4).

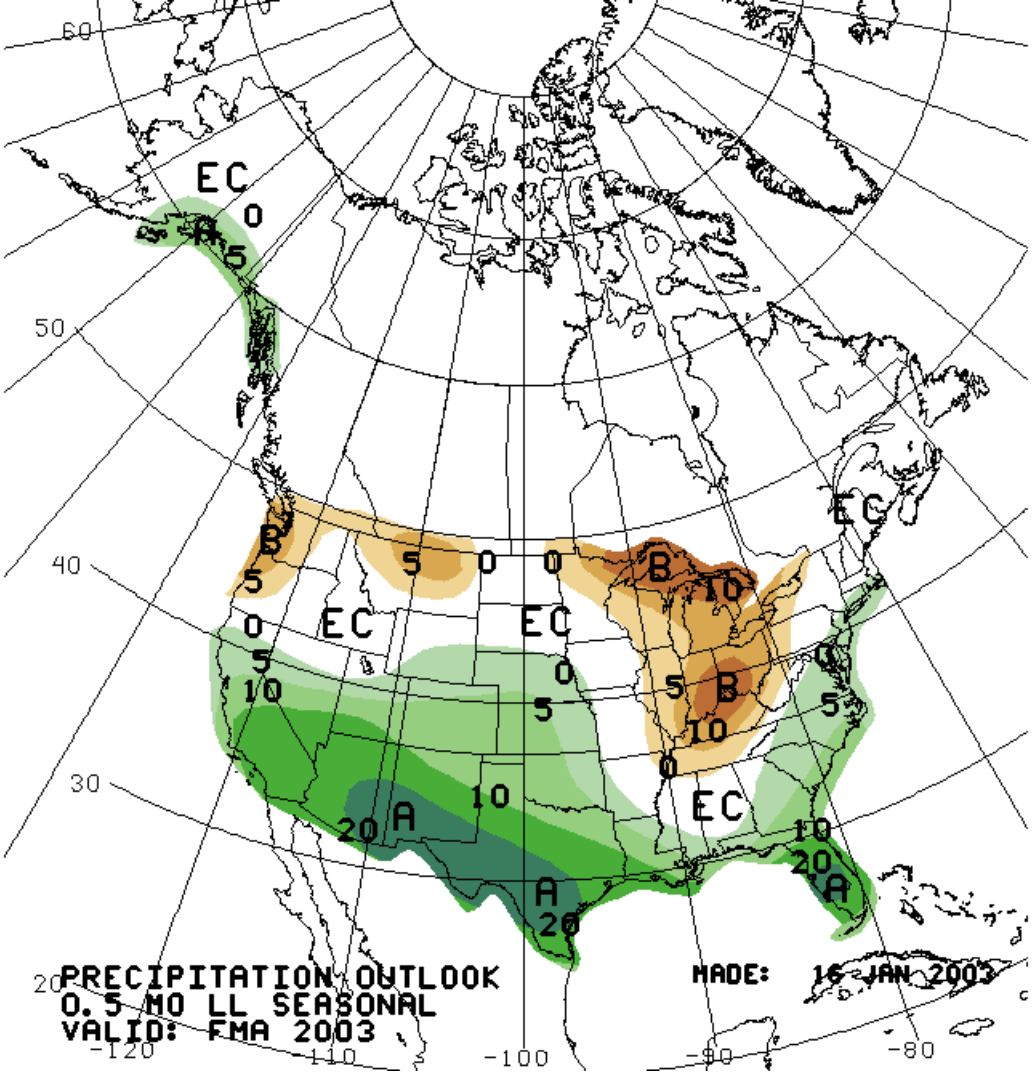


Figure 3. Precipitation Outlook for Feb, March & April, produced January 16. "Average" precipitation is expected for all of Idaho and the Oregon-California state line. Most of California can expect above average rainfall. Precipitation in coastal areas of Oregon and Washington will likely be below or well below average.

With reduced energy from low-cost hydro sources, BPA and Eugene are already anticipating a need to raise wholesale / retail electric rates by this fall. In the short term, warmer temperatures have reduced demand for energy used in heating during this, peak load season in the Northwest. A dry hydro year in the Northwest is not cause for immediate reliability concerns there or in California, but it is likely to significantly curtail amounts of energy made available by BPA on the wholesale spot market.

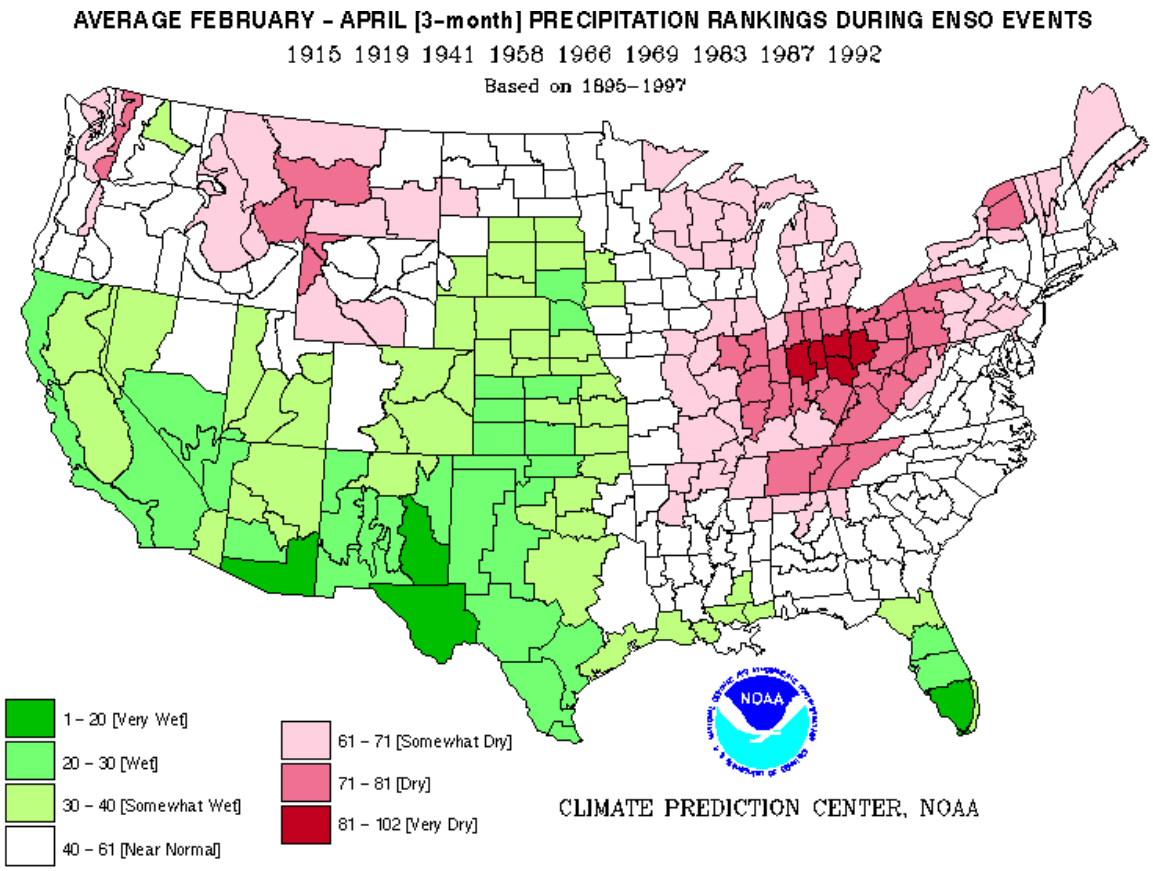
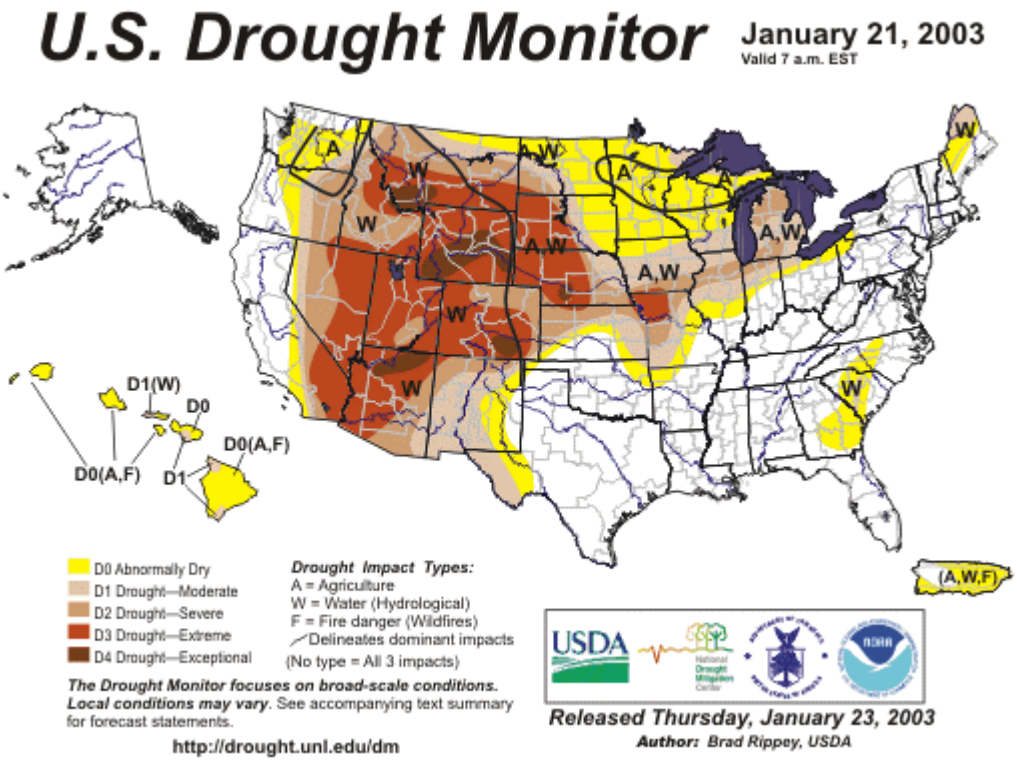


Figure 4. NOAA Climate Predictions for Feb-March-April 2003, based on precipitation patterns in *El Nino* ("ENSO") years. While apparently more precise than Figure 3, due to sharp boundaries, it is based on the same raw data. Note that 1983 (winter of 1982-83) is considered the mother of all *El Nino* years, and set the maximum runoff shown in Figure 2.

Colorado Basin

Drought continues to affect all of Colorado, Wyoming, Utah, Arizona, and most of Nevada, Idaho, Montana, and the western Dakotas (Figure 5). Water supplies are "extreme" to "exceptional" in most of Colorado and Wyoming. Lake Powell is at record low levels since it began filling in 1964. On the lower Colorado at Lake Mead, greatly reduced reservoir levels will reduce (moderately) energy and capacity output at Hoover Dam. Some drought relief is being forecast for Arizona and New Mexico, just as southern California has received more rainfall than record-dry last year.

Figure 5. Current drought conditions in the United States.



In 2002, most of interior southern California had an extreme or exceptional dry year. These effects are still evident, but are not worrisome, as this area is not a significant source of water supplies or waterpower. Since our last hydro snapshot, a series of political and media storms arrived on the lower Colorado River, centered around January 1st, as many others correctly forecasted. While national and regional attention has shifted elsewhere, conditions on the lower river and in the delta remain tame, stable, and well managed. Reduced water delivery schedules have been announced, and extreme drought conditions persist above Lake Mead.

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